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(56) Documents Cited

GB 2283162 A

GB 2255493 A

GB 2222025 A

GB 2185161 A

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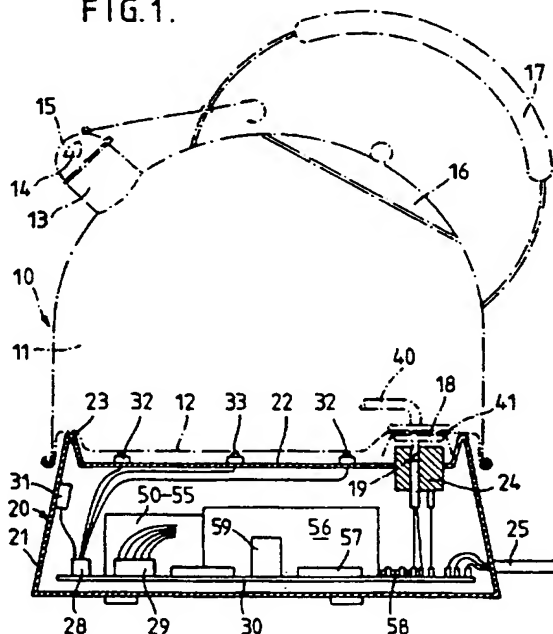
INT CL⁶ A47J 27/21 31/54 36/24

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(54) Heating vessel with electrical control means in stand

(57) A liquid heating apparatus comprises a vessel 10, such as a kettle, having a heating element 40, a stand 20 to receive the vessel, electrical supply means 24 and control means 30 located in the stand, the control means regulating the supply of electricity to the heating element. Preferably the control means includes heat responsive means 33 bordering the base 12 of the vessel so as to receive heat from heat conductive means (43, Fig 3) on the underside of the vessel. A circuit 70 on the control means may monitor resistance in the heating element so as to reduce/halt the supply of current when the resistance exceeds a predetermined value. The control means may comprise circuitry to test for contact between the heat responsive and heat conductive means. The control means may monitor the heat conductive means or the base of the vessel for leakages to earth. The control means may include minimum water quantity/level detection means in the form of a weight detector 32 or circuit 51. The control means may comprise timer circuitry 54, 55 which reduces the current supplied, for a predetermined period, on detecting whistling from the vessel.

FIG.1.



GB 2 299 497 A

FIG. 1.

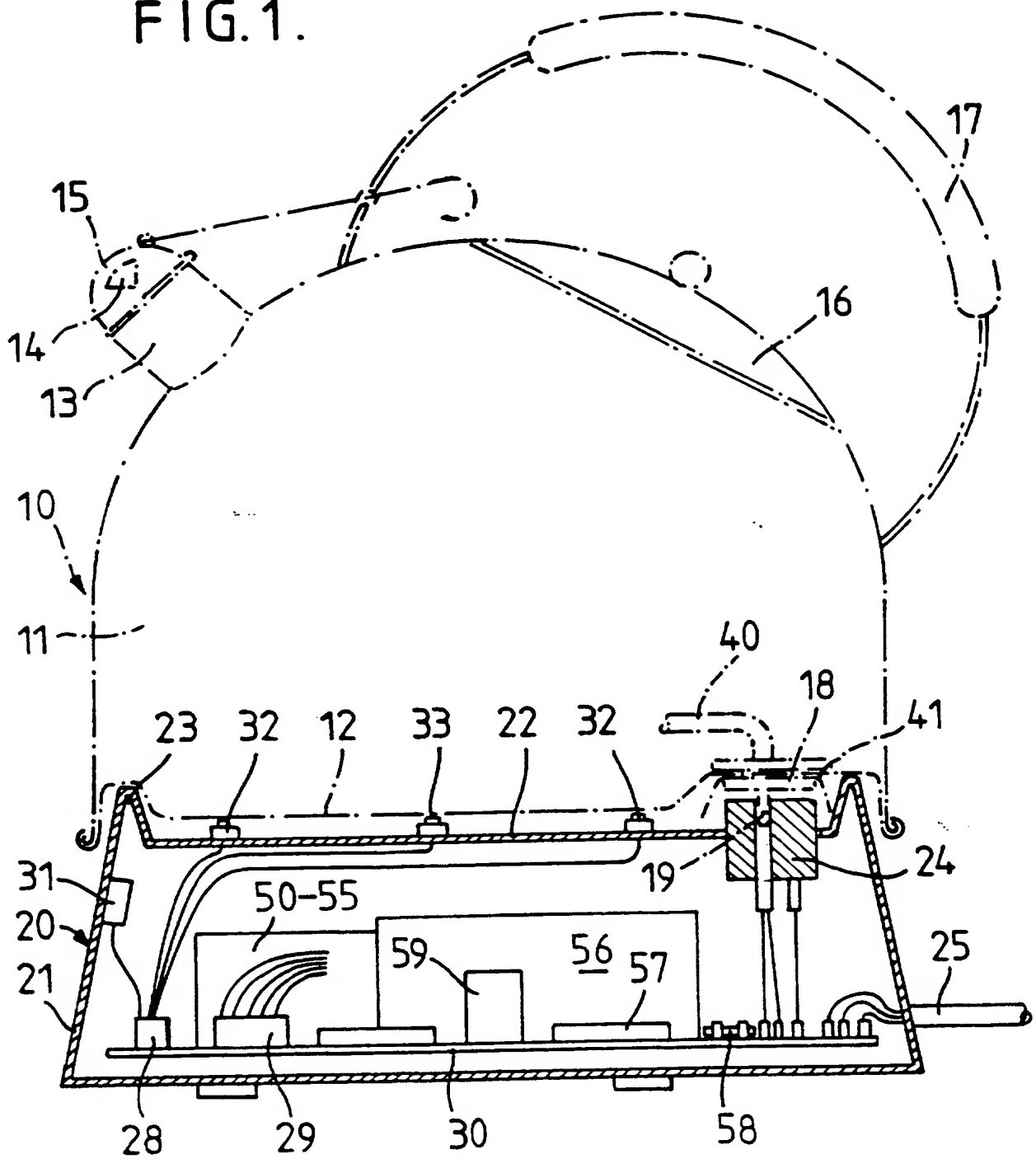


FIG. 2.

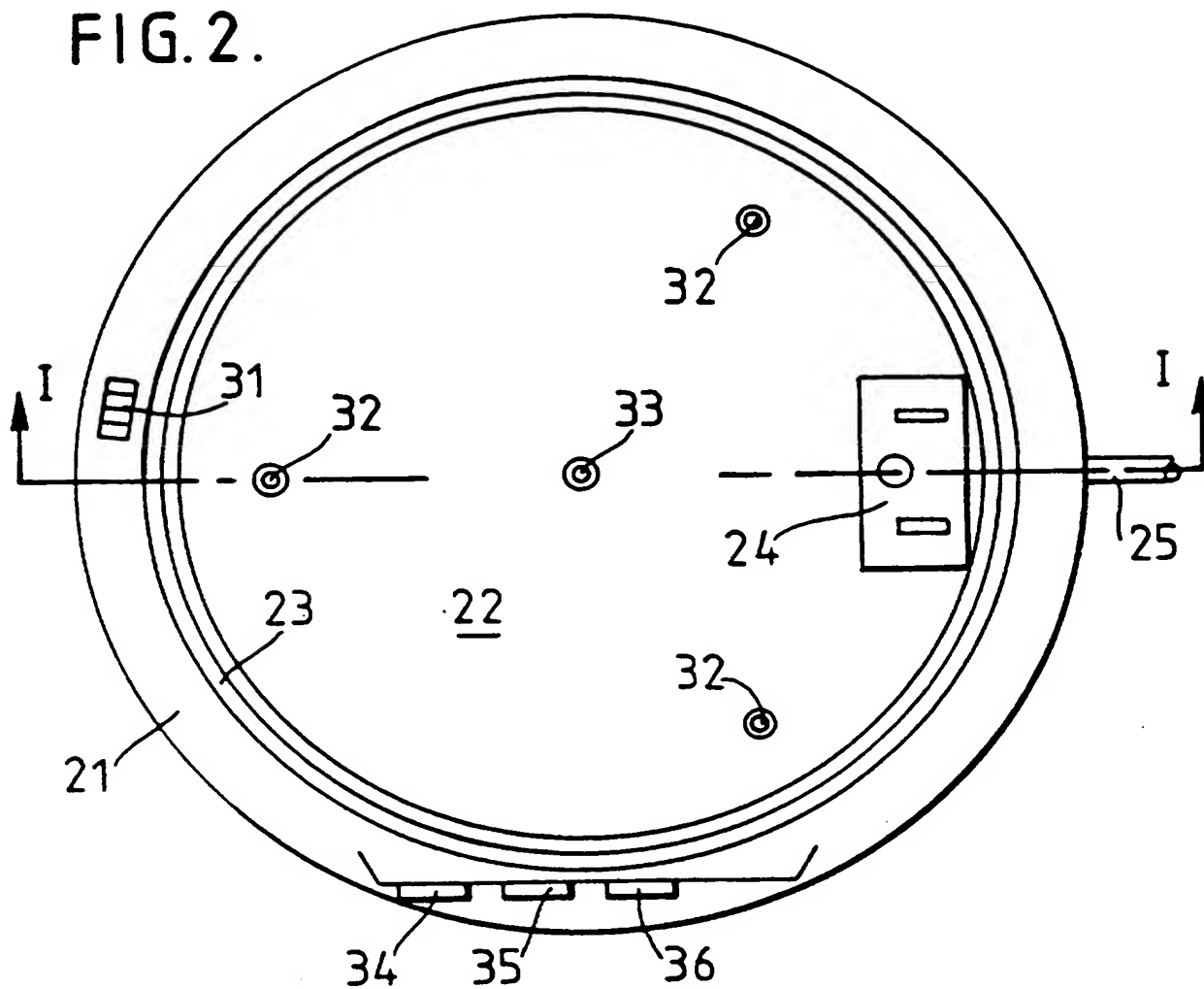


FIG. 3.

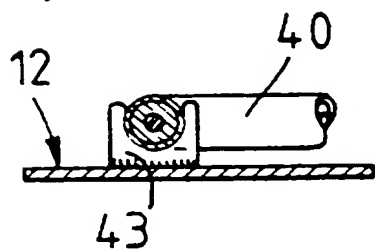
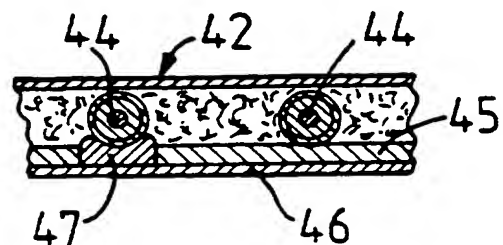


FIG. 4.



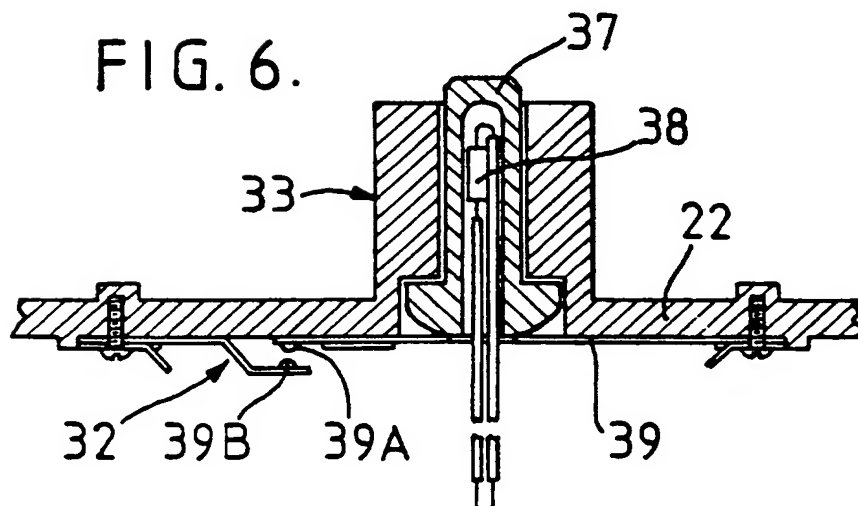
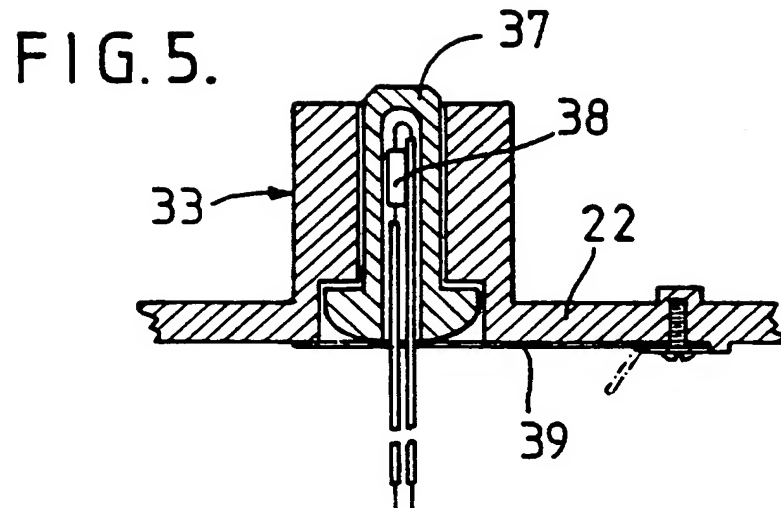
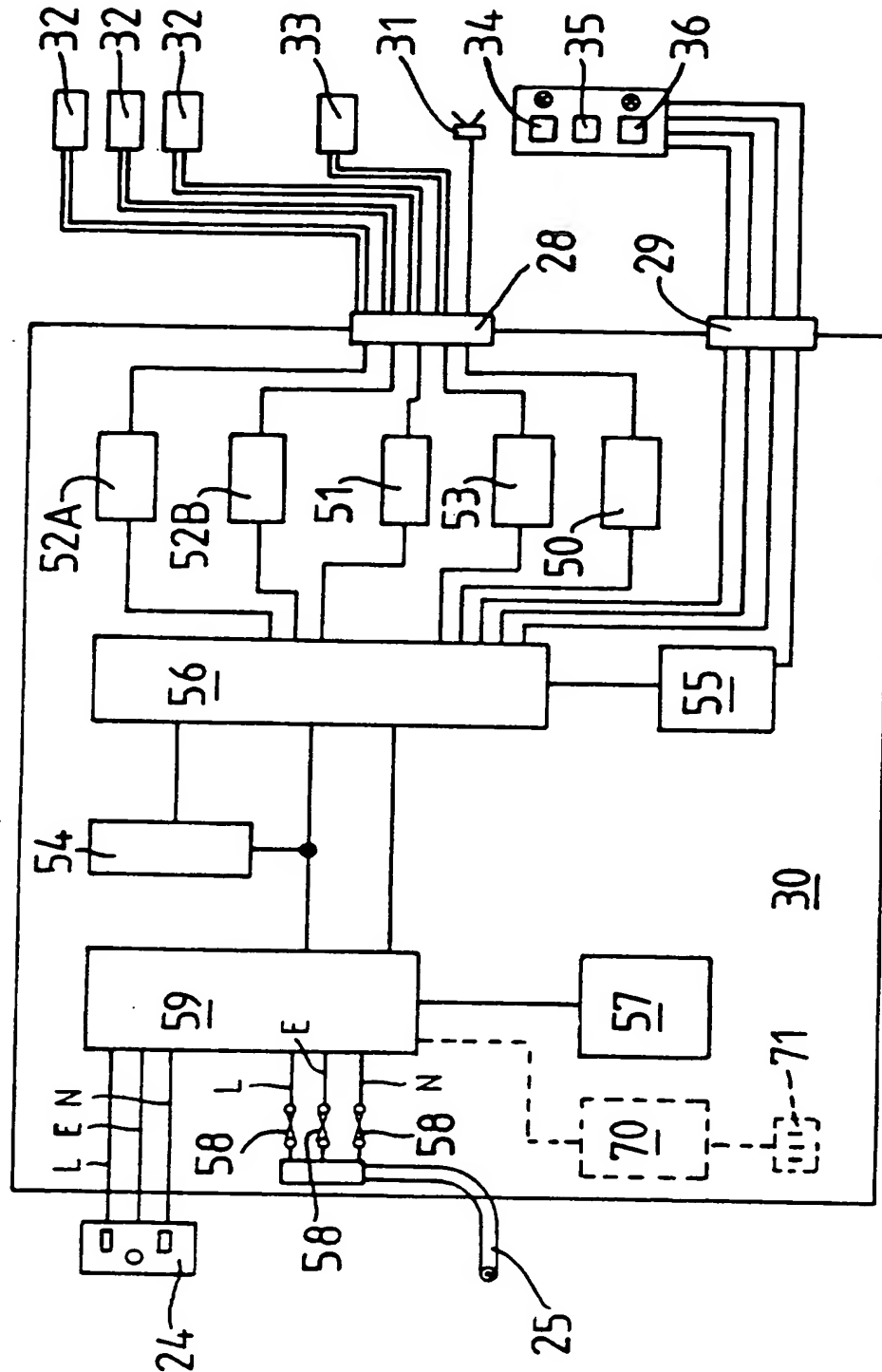


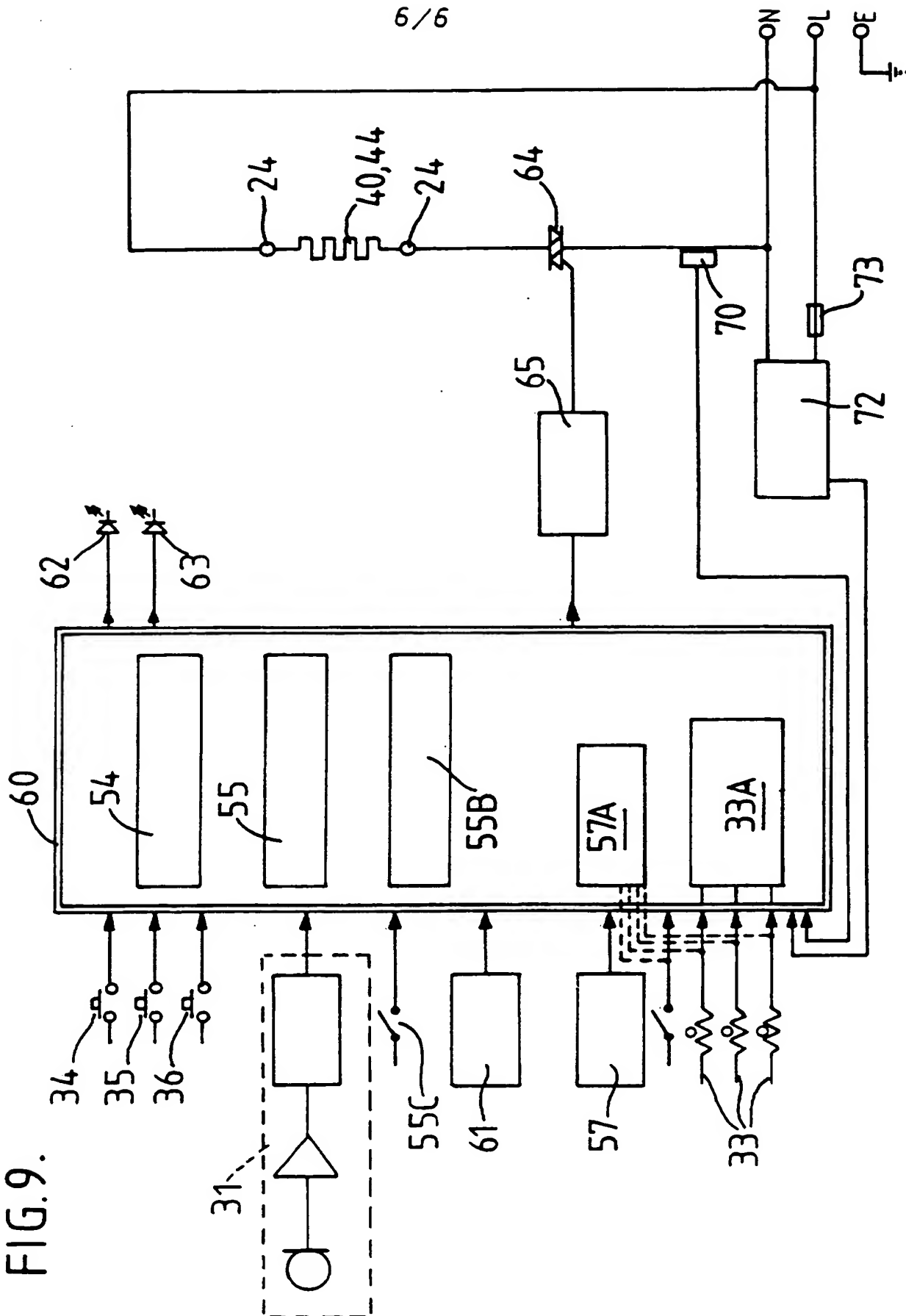
FIG. 7.



-60



FIG. 9.



VESSEL FOR HEATING LIQUIDS

This invention concerns vessels and apparatus for heating liquids such as electric kettles of a kind, commonly known as "cordless" which comprises a vessel
5 having a heating element, a stand to receive the vessel, separable electrical connection means to supply electric current from the stand to the heating element of the vessel, and control means or automatic switch means to switch off the current to the element automatically when
10 the liquid therein is boiling or in the event of overheating of the heating element.

In known cordless kettles of this kind the control means or automatic switch means is heat responsive and is
15 incorporated in the kettle, and gives rise to problems including weight which is users find undesirable, and the proximity of water sensitive operational and safety electrical circuitry of the automatic switch means to steam and water, which can give rise to malfunctions.

20

A reduction of the weight and the complexity of the kettle circuitry is afforded in the kettle disclosed in our GB-A-2255493, which kettle is formed as a whistling or humming kettle and the stand is provided with noise
25 sensitive switch means to respond to the sound produced by the kettle when steam is generated to actuate the whistle or other sound emitter of the kettle. However, the said problems remain especially in relation to the safety circuitry incorporated in the vessel, such as circuitry for

switching off of the element upon overheating.

In use, such electric kettles are difficult to clean because they are not suitable for immersion in water, and
5 are often seriously damaged or rendered dangerous by accidental immersion.

In order to further reduce or avoid such problems, a cordless electric vessel of said kind is, according to the
10 present invention, characterised in that the control means or automatic switch means is disposed in the stand and includes heat responsive means to confront a base of the vessel, to receive heat from heat conductive means on the underside of the vessel.

15

The heating element may be in the form of an immersion heater having a sheath in contact with said heat conductive means; may be incorporated in a sandwich form of the base; or may be disposed below said base so that a
20 sheath of said element can serve as the conductive means. The heat conductive means may comprise a thermally conductive part of the base or a member secured thereto.

The electric connection means preferably comprises a
25 supply connector in the form of a plug device attached to the base, and an input connector in the form of a socket device on the stand. The input connector is preferably arranged to, and optionally provided with a surface treatment or finish which tends to, repel water and/or

facilitate water being shed from the connector. The electrical and mechanical junctions between the element, plug device and base are preferably hermetically sealed to permit the kettle to be immersed wholly in water without
5 being damaged thereby.

The control means or automatic switch means preferably comprises circuitry to test electrically for mechanical contact between the heat responsive means and
10 the heat conductive means.

The control means or automatic switch means may comprise further test circuitry to monitor the electrical potential of said heat conductive means and/or said base, especially with reference to earth, for safety purposes,
15 e.g. to switch off the current in the event of electrical insulation failure of the insulation of the element; and/or to monitor the current supply circuit for any leakage current to earth, again for safety purposes.

20

The control means or automatic switch means preferably comprises minimum water quantity or level detection means comprising, for example, a kettle weight detector or means to monitor a voltage or current on a
25 water level probe in the kettle.

In embodiments in which the kettle is a whistling or humming kettle the control means or automatic switch means preferably comprises timer circuitry to delay switching off

of the element until said noise or sound has been received continuously for a specific, preferably presettable or adjustable, period; which circuitry preferably also provides a boil safety, period and is arranged to switch
5 off the element at the end of said period. The timer circuitry may also provide for a reduction of the current to the element after reception of said sound or noise signal and maintenance of said reduced current for a timed period hereinafter referred to as a "simmer period".

10

The kettle preferably has a skirt which extends below the remainder of the kettle to define a downwardly open recess accommodating at least the plug connector.

15 The invention further provides apparatus for heating liquids comprising an electrically powered heating vessel, a stand having an electrical supply connector to engage an electrical input connector mounted on the vessel, and control means to control the supply of electricity to a
20 heating element of the vessel, wherein said control means is provided in the stand and is arranged to monitor the ohmic resistance of the heating element and to reduce or halt the supply of current to the input connector upon said resistance becoming greater than a predetermined value.

25

The invention also provides apparatus of said kind which is characterised in that said control means is provided in the stand and is constructed and arranged to perform any one or any combination of the functions of:-

- (a) responding to a sonic signal, produced by the vessel upon the contents being heated to generate a flow of steam, to reduce the level of electrical power supplied to the vessel to a predetermined lower level for a predetermined period;
- (b) applying a test voltage to electrically conductive parts of the vessel by means of a plurality of probes or sensors and preventing the supply of power to the vessel in the event of failure of said probes or sensors to make good electrical contact with said vessel; and
- (c) electrically testing an electrically conductive part of said vessel via a probe or sensor and preventing power being supplied to the vessel in the event of an earth leakage current being detected.

The invention further provides a stand constructed for use in said apparatus.

The invention will be described further by way of example to the accompanying diagrammatic drawings, in which:-

FIGURE 1 is a part sectional diagram of a stand of an automatic cordless kettle apparatus of the invention with a kettle shown in broken outline;

FIGURE 2 shows the stand in plan view;

FIGURE 3 shows details of the base of a first form of kettle having an electric immersion heater;

5

FIGURE 4 shows details of the base of a second form of kettle having a sandwich construction base incorporating an electrical heater;

10 FIGURES 5 and 6 show details of two forms of sensor provided on the stand, and

FIGURES 7, 8 and 9 show block electrical circuit diagrams.

15 The apparatus includes a kettle 10 and a stand 20. The kettle has a body 11 having a metal base 12, a spout 13, a sound generator 14 (such as a whistle or harmonic reed device) in a pivotally displaceable cap 15 movable to open and close the spout, a lid 16 and a handle 17.

20

The stand 20 comprises a moulded plastics body 21 providing a platform 22 surrounded by a rim 23, and a socket device 24 of electrical connection means which further includes a plug device 18 fitted to the base 12.

25

The stand 20 is provided with control means or automatic switch means which includes a circuit board 30 which carries operational components of electrical circuitry described hereinafter which is connected by

connectors 28 and 29 to, and is arranged to respond to, sensors and manually actuatable controls to control the supply of heating current from a mains electrical supply cable 25 to the socket device 24.

5

The sensors include a sound sensor such as a microphone 31, at least one heat sensor 33 and at least one weight sensor 32 mounted on the platform 22; and the controls include "on", "off" and "simmer" switches 34, 35
10 and 36 mounted on the body 21.

The sound sensor 31 functions substantially as described in GB-A-2255493.

15 The or each heat sensor is arranged to abut the base of the kettle at a predetermined location.

A first form of the base 12 is used with a simple immersion heater having a sheathed element 40 connected by
20 a head 41 secured together with the plug device 18 to the base 12, which sheathed element 40 is supported above the or each said predetermined location by a thermally conductive clip 43 (FIGURE 3) secured to the base 12 to heat the base at said location or to conduct heat through
25 the base at said location.

In a second form (FIGURE 4), the base 12 is hollow and contains an element 44 (which is sheathed in this embodiment, but which may be of unsheathed sheet insulated

form) and has an upper panel 42 and lower panel 46 to sandwich the element 44 together with underlying insulation 45 to minimise heating of the lower panel 46 of the base except at said location whereat the insulation is interrupted and at least one part of the lower panel 46 is connected by thermally conductive member 47 to the element. The element 44 has a head (not shown) which is connected, together with the plug device 18, to the upper and/or lower panel 42 and/or 46 of the base.

10

In both forms the element is connected via cold tails, and optionally a fuse or fuses, directly with pins 19 of the plug device without any intervening switch mechanisms or circuitry.

15

The heat sensor 33 comprises a conductive hollow pin 37 (FIGURE 5) having a thermistor 38 held therein by thermally conductive resin or cement, which pin is upwardly biased by a spring 39. Each weight sensor 32 may be a similar pin without the thermistor, but one thereof is preferably combined with the heat sensor by the addition of a contact 39A on the spring and a static contact 39B on the platform to form the weight and heat sensor 33 shown in FIGURE 6.

25

As indicated in FIGURE 7, the electrical circuitry of the control means functionally comprises:-

(A) A sounding signal circuit 50 responsive to microphone

input from the sounding sensor 31 to respond by providing an "off" signal when the specific sound characteristically emitted by the sound generator has been received continuously for a predetermined minimum period.

- 5
- (B) A weight sensor circuit 51 to provide an "off" signal when the switch contacts 39A,B are open.
- 10 (C) Safety circuits 52A,B to provide "off" signals when a heat sensor faulty electrical contact or an earthing fault is detected which can, for example, be sensed via the spring 39 and pin 37 of the sensors 32 by checking for electrical continuity between the pins
- 15 via the base and for monitoring the potentials on the pins for any spurious voltage or faulty earthing of the kettle.
- (D) A heat responsive circuit 53 responsive to abnormal
- 20 thermistor resistance caused by overheating of the sensor 33 to give an "off" signal.
- (E) A heating limit timer circuit 54 to emit an "off" signal when upon elapse of a predetermined heating
- 25 period after switching on of the current supply to the kettle.
- (F) A simmer timer circuit 55 to emit a power reduction signal for a predetermined period after emission of

an "off" signal by the sounding signal circuit 50.

- 5 (G) A control circuit 56 to monitor or respond to the outputs of the circuits 50 to 55 and to switch on and off the power supply in response thereto and to inputs from the switches 34, 35 and 36, to enable the element to be energised when required subject to it being safe to do so and at the power level, "full" or "simmer", required.
- 10 (H) A residual current circuit-breaking circuit 57 to function in known manner in the electric power feeds to the element caused, e.g. by excess water on the plug device, or a faulty element.
- 15 (I) A resistance threshold or measuring unit 70 to test or monitor the resistance presented at the socket device 24 by the element 40 or 44 and the associated electrical circuit in the vessel, or to monitor the current drawn by said circuit, in order to provide a measure of the resistance of the element; and to switch off or reduce the level of power supplied to the element in the event of said measure of resistance increasing to a predetermined value. Said
- 20 predetermined value can be checked or determined experimentally by measuring the actual resistance reached when a test vessel is boiled dry or the element runs with a hot spot overheating, and setting the predetermined value below said actual value but
- 25

above the value achieved during normal boiling. To
accommodate vessels having different wattages,
predetermined values may be determined for each such
wattage and a preset control, e.g. a switchable
5 preset 71, may be provided.

(J) Fuses 58 in the electrical power feeds.

(K) A power output controller 59.

10

As indicated in FIGURES 8 and 9, the functions of the
circuits 50 to 56 are, at least partially, integrated
and/or performed by a microprocessor 60 or microprocessors,
and are only notionally represented by discrete blocks in
15 FIGURE 7. FIGURES 8 and 9 also show that, the circuitry
may comprise, as well as or instead of the weight sensor or
sensors, a water level circuit 61 to issue an "off" signal
when there is no circuit to earth, via water, between an
electrically conductive tip of an insulated probe
20 projecting within the kettle to a predetermined height
above the base. The circuitry or controls may also be
arranged to illuminate indicator lights 62,63 (FIGURE 8)
representing selection or operation of "boil" and "simmer"
functions. A further timer 55B is provided to give an
25 optional, selectable or preset "long boil" function, in
which boil determined switching off is delayed e.g. by
about 5 to 10 seconds; e.g. long boil may be selectable by
a switch 55C.

In the FIGURE 8 embodiment the socket device is energised by the microcontroller via relay RL and its contacts RL1 and RL2, and is arranged not to energise the element unless the plug device is correctly accommodated in
5 the socket device.

The microprocessor controls the measurement of the resistance of the element 40 by actuating the unit 70 at intervals to apply a test voltage to the contacts RL3 and
10 RL4, which unit provides a signal to the microprocessor representative of the resistance for comparison with the predetermined value stored in the microprocessor. Adjustment for vessels having several wattage ratings may be automatic, e.g. the thermistor signal may be used to
15 indicate when the element is "cold" e.g. at initial switch on, and the cold state first measured resistance may be used to determine the element wattage from which the microprocessor can select or determine the appropriate predetermined value.

20

The microcontroller and associated circuitry is energised from a stabilised low voltage power supply unit 72 protected by a fuse 73.

25 In the embodiment shown in FIGURE 9, no relay is used and the triac 64 controls the heating current. The unit 70 in this embodiment is an A/C current sensor which provides a signal to the microprocessor representative of the measured value. The power supply unit 72 also supplies to

the microprocessor a voltage signal representative of the actual mains voltage so that the actual resistance value can be determined for comparison. In this embodiment, adjustment for mains supplies of different voltage can be
5 achieved automatically by adapting the microprocessor to automatically reduce the mean energisation level of the element, e.g. by altering the on to off switching ratio of the triac 70.

10 In both embodiments, the simmer power level is controlled by the microprocessor 60 by means of the triac 64 via an isolator 65 to shield the microprocessor from mains voltage.

15 In both embodiments, an analogue to digital convertor 33A is provided to convert the DC thermistor sensor current to digital form for the microprocessor; and an electrical continuity and earth leak sensor 57A is provided to perform the function (C) aforementioned.

20

The invention is not confined to the foregoing examples, and many variations are possible within the scope of the invention. For example, instead of employing one or more separate thermally conductive members, the base or
25 lower panel may be formed at said locations to include thermally conductive portions raised to contact or be proximal to the element so as to be heated by conduction and/or radiation.

The plug device and any externally exposed surfaces adjacent thereto preferably have a surface finish or coating of water repellent form, and the plug device is preferably internally, and at its junction or junctions
5 with the head and base, sealed hermetically to prevent ingress of water when the kettle is immersed for washing, cleaning or even during filling.

The invention further includes and provides a kettle
10 or stand incorporating or provided with any novel part, combination of parts, operational feature or features or device or circuit or combination thereof disclosed herein and/or in the accompanying drawings, and functional equivalents thereof. For example, the kettle may have a
15 steam sensitive mechanism to move an abutment to actuate a switch of the control means instead of or as well as a whistle or other noise generator; or the kettle may have a steam tube to convey steam to such a mechanism on the stand, in which case the switch is preferably located in a
20 self draining compartment in the stand, separate from the accommodation for the remainder of the control means.

CLAIMS

1. Apparatus comprising a vessel having a heating element, a stand to receive the vessel, separable
5 electrical connection means to supply electric current from the stand to the heating element of the vessel, and control means or automatic switch means to switch off the current to the element automatically when the liquid therein is boiling or in the event of overheating of the heating
10 element; characterised in that the control means or automatic switch means is disposed in the stand and includes heat responsive means to confront a base of the vessel, to receive heat from heat conductive means on the underside of the vessel.

15

2. Apparatus for heating liquids comprising an electrically powered heating vessel, a stand having an electrical supply connector to engage an electrical input connector mounted on the vessel, and control means to
20 control the supply of electricity to a heating element of the vessel, wherein said control means is provided in the stand and is arranged to monitor the ohmic resistance of the heating element and to reduce or halt the supply of current to the input connector upon said resistance
25 becoming greater than a predetermined value.

3. Apparatus as claimed in Claim 2 wherein the control means or automatic switch means is disposed in the stand and includes heat responsive means to confront a base of

the vessel, to receive heat from heat conductive means on the underside of the vessel.

4. Apparatus as claimed in Claim 1 or 3 wherein the control means or automatic switch means comprises circuitry to test electrically for mechanical contact between the heat responsive means and the heat conductive means.

5. Apparatus as claimed in Claim 4 wherein the control means or automatic switch means comprises further test circuitry to monitor the electrical potential of said heat conductive means and/or said base, especially with reference to earth, and to monitor the current supply circuit for any leakage current to earth, for safety purposes.

6. Apparatus as claimed in Claim 4 or 5 wherein the control means or automatic switch means includes minimum water quantity or level detection means comprising a kettle weight detector or means to monitor a voltage or current on a water level probe in the kettle.

7. Apparatus as claimed in Claim 4, 5 or 6 wherein the kettle is a whistling or humming kettle producing a noise when steam is generated and the control means or automatic switch means comprises timer circuitry to delay switching off of the element until said noise or sound has been received continuously for a specific, presettable or adjustable period; which circuitry also provides a boil

safety period and is arranged to switch off the element at the end of said period.

8. Apparatus as claimed in Claim 7 wherein the timer
5 circuitry provides for a reduction of the current to the element after reception of said sound or noise signal and maintenance of said reduced current for a timed period.

9. Apparatus comprising a vessel having a heating
10 element, a stand to receive the vessel, separable electrical connection means to supply electric current from the stand to the heating element of the vessel, and control means or automatic switch means to switch off the current to the element automatically when the liquid therein is
15 boiling or in the event of overheating of the heating element and characterised in that said control means is provided in the stand and is constructed and arranged to perform any one or any combination of the functions of:-

20 (a) responding to a sonic signal produced by the vessel upon the contents being heated to generate a flow of steam to reduce the level of electrical power supplied to the vessel to a predetermined lower level for a predetermined period;

25

(b) applying a test voltage to electrically conductive parts of the vessel by means of a plurality of probes or sensors and preventing the supply of power to the vessel in the event of failure of said probes or

sensors to make good electrical contact with said vessel; and

- 5 (c) electrically testing an electrically conductive part of said vessel via a probe or sensor and preventing power being supplied to the vessel in the event of an earth leakage current being detected.

10 10. Apparatus substantially as hereinbefore described with reference to FIGURES 1 and 2; FIGURES 1 and 2 and any one of FIGURES 3 to 6; or FIGURES 1 and 2 and any one of FIGURES 7 to 8 of the accompanying drawings.

15 11. A stand constructed and arranged to serve as the stand of apparatus as claimed in any one of Claims 1 to 9.

20 12. A stand comprising control means substantially as herein described with reference to FIGURES 7, 8 or 9 of the accompanying drawings.



Application No: GB 9605424.2
Claims searched: 2-8 & 10-12

Examiner: Gavin Dale
Date of search: 12 July 1996

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A4A (AB1, AB2, ACA, APC)

Int Cl (Ed.6): A47J 27/21, 31/54, 36/24

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A,P	GB 2283162A (BLACK AND DECKER, INC) See Fig 1a	2,11
A	GB 2255493A (D H HADEN LTD) See page 2 line 26 to page 3 line 6	2,11
A	GB 2222025A (STRIX LIMITED) See page 7 lines 19-23	2,11
A	GB 2185161A (OTTER CONTROLS LIMITED) See Fig 4A and page 4 lines 23 to 31	2

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A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9605424.2
Claims searched: 9-12

Examiner: Gavin Dale
Date of search: 12 July 1996

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Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2255493A (D H HADEN LTD) See page 2 lines 1-8	9,11

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Application No: GB 9605424.2
Claims searched: 1,4-8,10-12

Examiner: Gavin Dale
Date of search: 7 May 1996

Patents Act 1977
Search Report under Section 17

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Int CI (Ed.6): A47J 27/21, 31/54, 36/24

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A	GB 2283162A (BLACK AND DECKER, INC) See Fig 1a and page 2 line 29 to page 3 line 11	1.11
A	GB 2255493A (D.H. HADEN LTD) See Fig 2 and page 3 lines 12-22	1.11
A	GB 2222025A (STRIX LIMITED) See page 6 line 26 to page 7 line 3 and page 7 lines 19-23	1.11

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E Patent document published on or after, but with priority date earlier than, the filing date of this application.